UNIVERSITY OF GONDAR

COLLEGE OF MEDICINE AND HEALTH SCIENCES

SCHOOL OF MEDICINE

DEPARTMENT OF OPTOMETRY

PREVALENCE AND ASSOCIATED FACTORS OF VISUAL IMPAIRMENT AMONG DIABETIC PATIENTS AT DEBRE BERHAN REFERRAL HOSPITAL, NORTH SHOA, ETHIOPIA, 2017

A THESIS REPORT SUBMITTED TO UNIVERSITY OF GONDAR, COLLEGE OF MEDICINE AND HEALTH SCIENCES, SCHOOL OF MEDICINE, DEPARTMENT OF OPTOMETRY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTERS DEGREE IN CLINICAL OPTOMETRY

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Acronyms

BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
DBRH	Debre Berhan Referral Hospital
DM	Diabetes Mellitus
DR	Diabetic Retinopathy
EPI info	Epidemiological Information
FBS	Fasting Blood Sugar
HIV	Human Immunodeficiency Virus
IOP	Intra Ocular Pressure
NLP	No Light Perception
PVA	Presenting visual acuity
RE	Refractive error
SPSS	Statistical Package for Social Sciences
VA	Visual Acuity
VI	Visual Impairment
WHO	World Health Organization

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Abstract

Background: Besides the continuous increase in the prevalence of diabetes mellitus, visual impairment has become a prevailing public health problem in diabetic patients, especially in developing countries. Evidences are limited on the prevalence and associated factors of visual impairment among diabetic patients in Ethiopia.

Objective: The aim of this study was to assess the prevalence and associated factors of visual impairment among diabetic patients at Debre Berhan referral hospital.

Methods and materials: A hospital based cross sectional study was carried out from April 27 to May 19, 2017. All adults with diabetes mellitus at Debre Berhan referral hospital were included in the study. Pre tested and semi structured questionnaire and ocular examinations were used to collect data. Data were entered into Epi Info 7 and exported to Statistical package for social sciences version 20 for analysis. The descriptive analysis was summarized by frequency, percent and summary statistics. Variables with p-value < 0.2 in bivariable binary logistic regression, were fitted to multivariable logistic regression. P-values of less than 0.05 were set to declare statistical significance. Adjusted odds ratio and 95% CI were used to determine the strength of association. Hosmer and Lemeshow goodness of fit was used to check for model fitness.

Result: A total of 388 study subjects participated in the study. The response rate was 92%. The median age of study participants was 45 years [IQR 30-56]. The prevalence of visual impairment was 29.38% (95% CI: 24.83%-33.93%). Age >56 years (AOR=9.7, 95% CI: 3.1-30.1), 46-56 years (AOR=3.2, 95% CI: 1.1-8.7), physical inactivity (AOR=2.1, 95% CI: 1.2 -3.7), history of eye examination (AOR=1.9, 95% CI: 1.05-3.4), lower body mass index (AOR=6.2, 95% CI: 2.1-18.9) and presence of visual symptoms (AOR=4.1, 95% CI: 2.2-7.6) had statistically significant association with visual impairment.

Conclusion and recommendation: About one third of diabetic patients had visual impairment. Diabetic patients are recommended to normalize their body mass index and have regular physical exercises.

Keywords: Diabetes mellitus, Ethiopia, Prevalence, Visual impairment

1 Introduction

1.1 Statement of the problem

Visual impairment is defined as presenting visual acuity of less than 6/18 in either eye (1).

Visual impairment is a significant public health issue in diabetic patients, particularly in developing countries (2). More than ten percent of diabetic patients develop visual impairment within 15 years of diagnosis (3). Diabetes mellitus (DM) is one of the top and most preventable cause of new cases of blindness in adults aged 20–74 years in the United States (4, 5). Visual impairment is highly prevalent in diabetic patients. Several studies done in Africa and other parts of the world has shown that the prevalence of visual impairment among diabetic patients were between 16.7% and 55% and some factors associated with visual impairment were reported (6-12).

Visual impairment can result in loss of productivity and dependency. In addition, the frequent health service use by diabetic patients makes diabetes mellitus more expensive disease that can pose large economic challenges on diabetic patients themselves, their families and countries and national health systems at large. Many countries spend between 5% and 20% of their total health expenditure on diabetes (13).

Despite this economic challenges, the prevalence of DM is progressively increasing from time to time which in turn increases the number of visual impairment among diabetic patients (6, 13). Evidence based actions are required to prevent and avoid visual impairment in diabetic patients (6)

However, evidences are limited on the prevalence and associated factors of visual impairment among diabetic patients in Ethiopia.

Diabetic eye disease is among the priorities of vision 2020 “the right to sight’’, to eliminate avoidable blindness from the world by the year 2020, in which Ethiopia is a member state. Because of lacking evidences, it is difficult to speak about the

progress of the visual impairment. Providing information on the magnitude as well as factors associated with visual impairment in diabetic patients may be helpful to advocate for greater political and financial commitment and for proper allocation of resources, so that effective delivery of eye care services is possible for diabetic patients in avoiding avoidable visual impairment (6, 14). It also helps as a baseline for monitoring, follow-up and evaluation of programs.

Therefore the aim of this study was to estimate the prevalence of visual impairment and associated factors among diabetic patients.

1.2 Literature review

1.2.1 Prevalence of visual impairment in diabetic patients

Visual impairment in diabetic patients is high. Several studies done in different parts of the world showed that the prevalence of visual impairment among diabetic patients was between 16.7% and 55% (4, 6-12).

In the United States, DM is the principal cause of new cases of blindness among adults aged 20–74 years (4). Around 4.2 million (28.5%) people had diabetic retinopathy between the year 2005 and 2008 among diabetics aged 40 years or older, that may have resulted some sort of vision loss (4). It has been reported in 2002 by the Centers for disease control and prevention (CDC) that the prevalence of visual impairment among diabetics ≥18 years old was 23.5% (11).

A cross sectional survey of type 2 diabetes in China, Xinjing town in 2015 has shown that 8.5% of the eyes had moderate or severe visual impairment and 3.7% of the eyes were blind with best possible correction (8). In a multi ethnic Asian study in Singapore the prevalence of bilateral blindness was 1.5% and bilateral visual impairment was 26.8% (15).

Cross sectional studies conducted in Africa has revealed different figures on the prevalence of visual impairment among diabetics. The prevalence of visual impairment among diabetics was 44.9% in a South Africa in 2014 (16), 22.2% in a Tunisia in 2014 (7), 16.7% in Nigeria (Maiduguri Teaching Hospital) in 2012 (17), and 22.6% in Cameroon in 2014 (9).

A retrospective observational study of diabetic patients done in 2011 in Yemen, showed the prevalence of visual impairment and blindness to be 39.3% and 15.7% respectively (12).

The Ugandan hospital based cross sectional study on diabetic patients who were 18 years old and above revealed that the prevalence of visual impairment to be 28.6% (18).

In Ethiopia, evidences regarding the prevalence of visual impairment among diabetic patients were not found.

1.2.2 Factors associated with visual impairment in diabetic patients

Factors associated with visual impairment among people with DM were identified in different studies. However, the factors varied across studies (7-9, 12, 15, 16, 18).

Older age is the most consistently associated factor with visual impairment in people among diabetes mellitus in most studies (7, 8, 12, 15, 16, 18)

In a cross sectional survey done on type 2 diabetes mellitus patients in china, Xinjing town, in 2016: female gender and earlier onset of diabetes were positively associated with visual impairment (visual acuity < 20/63 in the better eye) (8).

In a multi-ethnic Asian study done in 2012 in Singapore; male gender, lower body mass index (BMI) and longer duration of DM were positively associated with bilateral visual impairment (15).

In a cross sectional study in South Africa, 2014 (16) monthly income were significantly associated with visual impairment, whereas in Tunisia, 2014 (7) duration of DM >10 years, obesity and high blood pressure were positively associated with visual impairment. Physical activity was negatively associated with visual impairment in the South African (16) study.

Severely impaired vision <6/60 had positive association with duration of DM ≥10 years, and hypertension in a cross sectional study in Cameroon, 2015 (9).

In Yemen, male gender, mode of treatment (ocular hypoglycemic agents and diet), duration of DM (5-9 years) were positively associated with presence of visual impairment (12).

Age >59 years and history of visual complaint on presentation were positively associated with visual impairment in Ugandan in 2016 (18).

The factors associated with visual impairment related with DM are undetermined in Ethiopia.

1.2.3 CONCEPTUAL FRAMEWORK

The conceptual frame work was developed by reviewing different literatures (7-9, 12, 15, 16, 18).

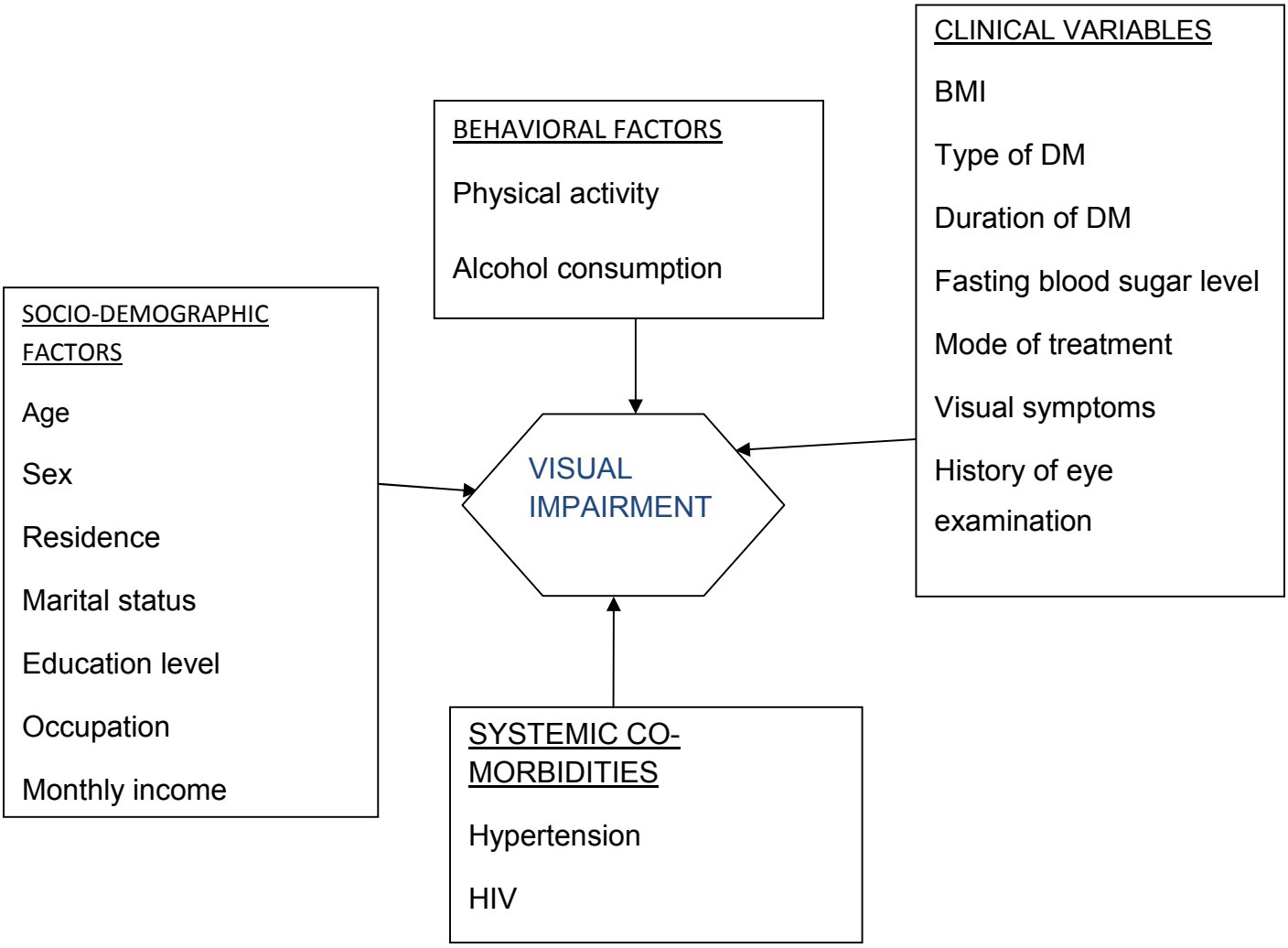


Figure 1 Conceptual Framework showing association of factors with visual impairment among adults with diabetes mellitus

1.3 **Justification of the study**

Prevalence of visual impairment is high among diabetic patients according to studies done in Africa and different parts of the world. Evidence on prevalence and associated factors of visual impairment among Ethiopian diabetic patients were not found. In addition, the reported prevalences of visual impairment among diabetic patients in Africa and other parts of the world have wide discrepancies. Determining the prevalence of visual impairment among diabetic patients may be helpful in proper allocation of resources.

The factors in Ethiopian diabetic patients may be different from other studies due to socio-cultural and economic variations. Identifying the factors could be useful to the health authorities in planning for the prevention and elimination of modifiable factors associated with visual impairment among people with DM.

2 Objectives

2.1 General objective

- To assess the prevalence and associated factors of visual impairment among adults with diabetes mellitus attending Debre Berhan referral hospital, North Shoa, Ethiopia, 2017.

2.2 Specific objectives

- To estimate the prevalence of visual impairment among diabetic patients at DBRH.
- To identify factors associated with visual impairment among diabetic patients at DBRH.

3 Methods and materials

3.1 Study design

A hospital based cross sectional study was conducted.

3.2 Study area and period

The study was conducted at DBRH from April 27/2017 to May 19/2017. DBRH is found in North Shoa zone of Amhara National Regional State which is located 130 km north of Addis Ababa, the capital city of Ethiopia. It is the only referral hospital and the only eye center in North Shoa zone and has a catchment of approximately 2.8 million people according to the data obtained from DBRH health information department. It mainly receives patients from North Shoa zone of Amhara region and partly from Oromia and Afar regions. General practitioners, Internists and nurses were involved in the clinical service of diabetic patients.

3.1 Source population/study population

All adults aged ≥ 18 years with DM, attending DBRH.

3.1.1 Inclusion criteria

All adults with diabetes mellitus aged ≥ 18 years, attending DBRH.

3.2 Sample size determination

Previous evidences on the prevalence and associated factors of visual impairment among diabetic patients in Ethiopia were not found. Therefore, 50% was used as the hypothesized proportion of visual impairment among diabetic patients to calculate the sample size. Single proportion formula was used to determine the sample size.

$$n = \frac{\left(Z_{\alpha/2}\right)^2 P(1-P)}{d^2}$$

Where; n – sample size,

Z is Value of z statistic at 95% confidence interval = 1.96

P – Hypothesized proportion of visual impairment in diabetic patients in Ethiopia = 50%.

1-P = 1-0.50 = 0.50

d – Maximum allowable error (marginal error) 5% = 0.05

$$\text{sample size}(n) = \frac{(1.96)^2 0.50(1-0.50)}{0.05^2} = 384$$

With 10% non response rate, the final sample size was 422.

3.3 Sampling

All consecutive adults aged ≥18 years with DM during the data collection period and who consented to participate were included in the study.

3.4 Variables of the study

3.4.1 Dependent variable

Visual impairment among diabetic patients

3.4.2 Independent variables

Socio-demographic factors: Age, Sex, Religion, Ethnicity, Residence, Marital status, Education level, Occupation and Monthly income

Clinical variables: Body mass index, Type of DM, Duration of DM since diagnosis, Fasting Blood sugar level, Mode of treatment History of eye examination and Visual symptoms

Systemic co-morbidities: Hypertension and HIV status

Behavioral factors: Physical activity and Alcohol consumption

3.5 Operational definitions

Visual impairment

Visual impairment was defined as presenting visual acuity worse than 6/18 (<6/18 - NLP). Visual impairment was further categorized in to moderate visual impairment (PVA < 6/18 - 6/60), sever visual impairment (PVA < 6/60 - 3/60), blindness (PVA < 3/60 - NLP), monocular moderate visual impairment (presenting distance VA of <6/18 - 6/60 in one eye and 6/6 - 6/18 in the other eye), monocular severe visual impairment (PVA < 6/60 - 3/60 in one eye and 6/6 - 6/60 in the other eye) and monocular blindness (PVA < 3/60 - NLP in one eye and PVA of 6/6 - 3/60 in the other eye) (1).

Body Mass Index (BMI)

BMI (kg/m^2) was calculated as weight (kg) divided by height in square meters (m^2) and was graded according to the WHO classification. A BMI of <18.5 was underweight, a BMI of 18.5- 24.9 kg/m^2 was normal, a BMI of 25–29.9 kg/m^2 was overweight and a BMI of ≥ 30 kg/m^2 was obese (19).

Alcohol consumption

Those who drunk more than 4.67 units of drinks on any single day (around 2 pints of 4% beer or 2 medium (175 milliliter) glasses of 13% wine) and more than 14 units of drinks per week (6 pints of beer or 1.4 bottles of 13% wine) were considered as drinkers. Those who drunk lower than this level were considered as non drinkers (20).

Physical exercise: people who performed at least 75 minutes of aerobic physical activity throughout the week like running, bicycling, jumping rope, and swimming were considered as engaged in physical activity, but those who performed less than this were not considered as engaged in physical activity (21).

History of eye examination: people who had been examined their eyes after the diagnosis of DM and before the data collection time were considered as examined and people who was not examined were considered not examined.

Visual symptoms: people who had symptoms like blurring of vision, flashing of light, floaters, halos or visual field loss at the time of data collection were considered as symptomatic. Those who hadn't visual symptoms were considered as asymptomatic.

Fasting blood sugar: FBS level of >126mg/dl was considered as hyperglycemia and <126mg/dl was normal (22).

Urban: the presence of infrastructures like paved streets, electric lighting, sewage or based on economic functions where the majority of the population is not primarily engaged in agriculture, or where there is surplus employment (23). Population not classified as urban constitute rural.

3.6 Data collection procedures and personnel

The Amharic version of pretested and structured interviewer administered questionnaire and ocular examinations were used to collect data. Snellen's E chart, pinhole disc, schiotz tonometer, pen torch, slit lamp biomicroscope, direct ophthalmoscope, Volk and binocular indirect ophthalmoscope were used for ocular examination. Digital balance was used for weight measurement and meter tape was used for height measurement.

Three nurses, two Optometrists were involved in the data collection process. After getting the informed consent by the principal investigator at the chronic disease department, two nurses interviewed the study participants on the interview part of the questionnaire including demography, behavioral factors and systemic co-morbidities. Regarding the clinical data, the nurses also interviewed the study participants about duration of DM, mode of treatment and presence of visual symptoms, took measurements on weight and height, and referred patients' folder to note on the type of DM and FBS level. The patients' folder was marked after relevant data were collected to avoid repeated collection of data on the same patient. The patient was then sent to Ophthalmology department to undergo ocular examinations. The vision was measured by the third nurse and the IOP was measured by Optometrists. First distance presenting visual acuity was measured using Snellen’s

E chart at 6 meters. When the patients' presenting distance VA was worse than 6/18 a pinhole vision was checked to rule out refractive error. When the vision was improved with pinhole, refractive error was recorded in the ocular abnormalities list. The presenting visual acuity was recorded in a fraction notation. IOP was measured using schiotz tonometer and recorded in mmHg.

Anterior and posterior segment examinations were done by two Optometrists in the Ophthalmology department. Anterior segment examination was done using pen torch and slit lamp biomicroscope for study participants and posterior segment examination was done using direct ophthalmoscope. Pupilary dilatation and funduscopy with 90D/78D Volk or binocular indirect ophthalmoscope was used to examine the posterior segment in cases where direct ophthalmoscopy was not adequate. When pupil dilation was needed, it was done using 1% tropicamide eye drop. At the end of ocular examination each patient was told about his/her vision status and eye conditions. Patients were linked to ophthalmology department for further treatment, follow up and/or referral when necessary.

3.7 Data quality assurance

After translating the English version of the questionnaire to Amharic, the Amharic version of the questionnaire was pre tested to assure for the appropriateness and translated back to English.

All the data collectors (three Nurses, two Optometrists and one Ophthalmologist) were trained for one day about the data collection process. Unclear issues on data collection were solved by the primary investigator. Cronbach's alpha was used to check the reliability of the questionnaire.

Each day during the data collection 5% of the data was cross checked for completeness by principal investigator.

3.8 Data analysis

After data was checked for completeness and consistency it was coded and entered in to EPI info 7 and exported to SPSS version 20 for analysis. The descriptive

statistics was summarized using summary statistics such as frequency tables, graphs, percentages, means, medians, quartiles and standard deviations. Binary logistic regression was used to identify factors associated with visual impairment. Variables with p-value < 0.2 in bivariable binary logistic regression, were fitted to multivariable logistic regression. P-values of less than 0.05 were set to declare statistical significance. Adjusted odds ratio and 95% CI were used to determine the strength of association. Hosmer and Lemeshow goodness of fit was used to check for model fitness.

3.9 **Ethical considerations**

Ethical clearance was obtained from University of Gondar, College of Medicine and Health Sciences, school of medicine ethical review committee. Permission was obtained from Debre Berhan referral hospital to conduct the data collection process. Informed consent was obtained from each study participants after explaining the purpose of the study. They were given full right to participate, refuse or with draw the study at any time they want. Confidentiality of the information obtained was assured by coding and locking the data.

Diabetic patients with visual impairment and other ocular problems were linked to the ophthalmology department for treatment, follow up and/or referral. All study participants were advised about the importance of regular ocular screening even in the absence of any visual symptoms or problems.

4 Results

4.1 Socio-demographic characteristics of study participants

A total of 388 participants were included in this study. The response rate was 92%. The median age of study participants was 45 years [IQR 30-56]. Males were 208 (53.6%) and 359 (92.5%) were Orthodox Christians. Most of study participant were urban residents 253 (65.2%) and Amhara 326 (84%) in ethnicity. The median monthly income was ETB 700 [IQR of 400-2000 ETB]. (see table 1)

Table 1: Socio-demographic characteristics of diabetic patients at Debre Berhan referral hospital, Ethiopia, 2017 (n=388)

Variable	Frequency	Percentage
Age (years)		
18-30	109	28.1
31-45	96	24.75
46-56	87	22.4
>56	96	24.75
Sex		
Male	208	53.6
Female	180	46.4
Religion		
Orthodox	359	92.5
Muslim	22	5.7
Protestant	7	1.8
Ethnicity		
Amhara	326	84.0
Oromo	41	10.6
Tigrie	4	1.0
Guragie	17	4.4
Marital status		
Currently single	134	34.5
Currently married	254	65.5

Educational status		
Can't read and write	111	28.6
Read and write only	71	18.4
Primary school	49	12.6
Secondary school	61	15.7
College/University	96	24.7
Occupation		
Employed	80	20.6
Merchant	31	8.0
Farmer	77	19.8
House wife	86	22.2
Retired	50	12.9
Not employed	64	16.5
Residence		
Urban	253	65.2
Rural	135	34.8
Monthly income		
<400 ETB	66	17.0
400-699 ETB	104	26.8
700-1999 ETB	115	29.6
≥ 2000 ETB	103	26.6

n = sample size

4.2 Clinical and behavioral characteristics of study participants

Type 2 diabetic patients were 228 (58.8%).The median for duration of diabetes was 3.5 years [IQR 2- 6.75]. The minimum duration of diabetes after diagnosis was one day and the maximum was 28 years. The median for FBS was 147.5mg/dl [IQR 113-188.75]. About 364 (93.8%) of diabetic patients do not drink alcohol, 225 (58%) were engaged in physical activities and 200 (51.5%) had history of eye examination. (see table 2 below)

Table 2: Clinical and behavioral characteristics of adults diabetic patients at Debre Berhan referral hospital, Ethiopia, 2017 (n=388)

Variables	Category	Frequency	Percentage
BMI	Under weight	25	6.4
	Normal	260	67.0
	Over weight	97	25.0
	Obese	6	1.5
Type of DM	Type 1	160	41.2
	Type 2	228	58.8
Duration of DM (years)	<5	232	59.8
	[5-10)	99	25.5
	[10-15)	33	8.5
	15+	24	6.2
FBS level (mg/dl)	Normal	139	35.8
	Hyperglycemic	249	64.2
Mode of treatment	Tablets	169	43.6
	Insulin injection	214	55.2
Visual symptoms	Symptomatic	204	52.6
	Asymptomatic	184	47.4
Alcohol consumption	Yes	24	6.2
	No	364	93.8
Physical exercise	Yes	225	58
	No	163	42
eye exam history	Yes	200	51.5
	No	188	48.5

4.3 Systemic co-morbidities of study participants

Systemic hypertension was found in 95 (24.5%) of DM patients and 21 (5.4%) were HIV positive. (See table 3 below)

Table 3: Systemic co-morbidities of adults with diabetes mellitus at Debre Berhan referral hospital, Ethiopia, 2017 (n=388)

Variables	Category	Frequency	Percentage
HTN	Yes	95	24.5
	No	293	75.5
HIV status	Negative	328	84.5
	Positive	21	5.4
	Not known	39	10.1

n = sample size

4.4 Prevalence of visual impairment in diabetic patients

The prevalence of visual impairment among adults with diabetes mellitus was found to be 29.38% (95% CI: 24.7%-34.3 %). (see fig 2 below)

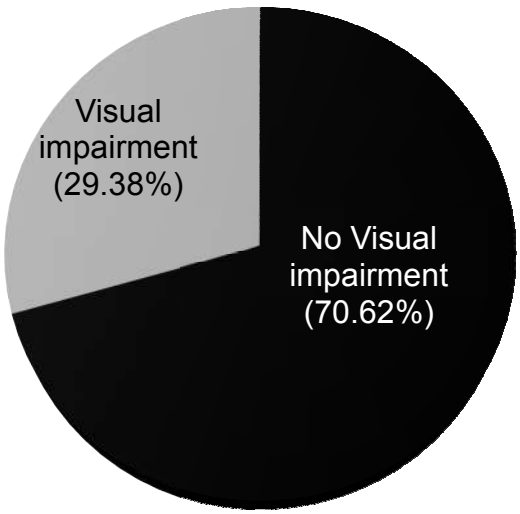


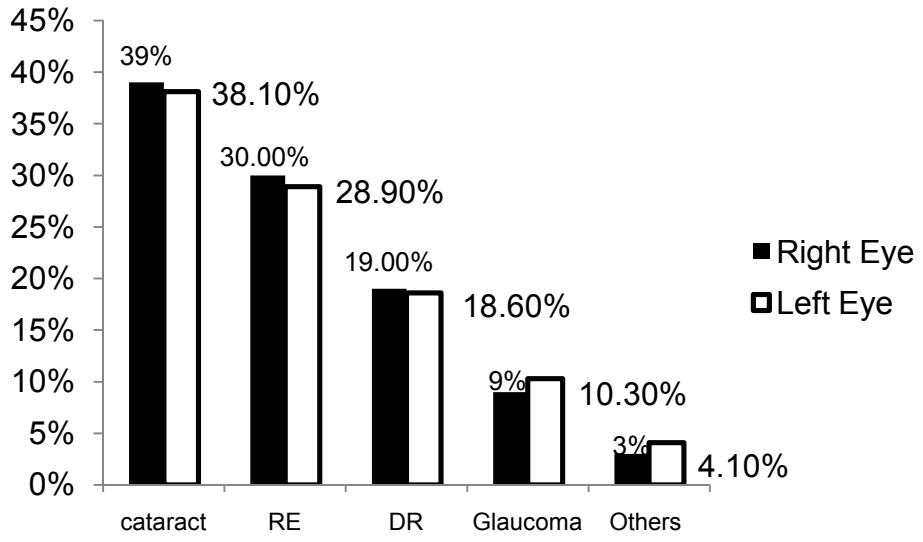
Figure 2: Pie chart showing prevalence of visual impairment among adults with diabetes mellitus attending Debre Berhan referral hospital, Ethiopia, 2017

Nearly half (49.1%) of the patients with visual impairment were in the moderate visual impairment category. (See table 4 below)

Table 4: Frequencies of visual impairment categories among diabetics with visual impairment at Debre Berhan referral hospital, Ethiopia, 2017

Visual impairment Category		Frequency	Percentage
<6/18-6/60	Bilateral Moderate VI	56	49.1
<6/60-3/60	Bilateral Sever VI	6	5.3
<3/60-NLP	Bilateral Blindness	6	5.3
<6/18-6/60, other eye 6/6-6/18	Monocular Moderate VI	28	24.6
<6/60-3/60, other eye 6/6 - 6/60	Monocular Sever VI	11	9.6
<3/60-NLP, other eye 6/6- 3/60	Monocular Blindness	7	6.1
	Total	**114**	**100.0**

The most common ocular abnormalities seen in diabetic patients with visual impairment attending DBRH was Cataract, Refractive error, DR and Glaucoma. (See fig 3)



RE = Refractive error DR= diabetic retinopathy

Figure 3: Common ocular abnormalities found in diabetics with visual impairment at Debre Berhan referral hospital, Ethiopia, 2017

4.5 Factors associated with visual impairment in diabetic patients

From bivariable analysis Age, occupation, residence, income, alcohol consumption, physical activity, presence of visual symptoms, type of DM, duration of DM, mode of treatment, BMI, HIV status, hypertension and history of eye examination were selected and fitted to multivariable analysis.

Using Enter method in multivariable analysis, variables that had statistically significant association with visual impairment in diabetic patients at Debre Berhan referral hospital were age, physical inactivity, history of eye examination, lower BMI and presence of visual symptoms.

The odds of visual impairment in old age >56 years was nearly 10 times (AOR=9.7, 95% CI: 3.1-30.1) than that of age 18-30 years, whereas diabetics aged 45-56 years were about 3 times (AOR=3.2, 95% CI: 1.1-8.7) to have visual impairment than age18-30 years. The odds of visual impairment in diabetics who were not engaged in physical exercise was 2 times (AOR=2.1, 95% CI: 1.2 -3.7) as compared to those who performed physical activities. The odds of visual impairment for people who had history of eye examination was about two times (AOR=1.9, 95% CI: 1.05-3.4) than those who hadn't. Underweight (lower BMI) diabetics were about six times (AOR=6.2, 95% CI: 2.1-18.9) likely to have visual impairment than normal weighted diabetic individuals. Visual impairment was about four (AOR=4.1, 95% CI 2.2-7.6) times in diabetic patients who had visual symptoms at the time of data collection than those hadn't. (see table 5 below)

Table 5: Factors associated with visual impairment among diabetic patients at Debre Berhan referral hospital, Ethiopia, 2017

Variable	Visual Impairment Yes	No	COR(95%CI)	AOR(95%CI)
Age (years)				
18-30	14	95	1	1
31-45	13	83	1.06 (0.47-2.39)	1.32(0.49-3.5)
46-56	27	60	3.05 (1.5-6.3)	3.2 (1.1-8.7)*
>56	60	36	11.3 (5.6-22.7)	9.7 (3.1-30.1)***
Sex				
Male	60	148	1	
Female	54	126	1.06 (0.68-1.64)	
Marital status				
Currently single	44	90	1.29 (0.82-2.02)	
Currently married	70	184	1	
Educational status				
Can't read and write	38	73	1.4 (0.77-2.5)	
Read and write only	20	51	1.06 (0.5-2.1)	
Primary school	14	35	1.07 (0.5-2.32	
Secondary school	16	45	0.96 (0.5-1.9)	
College/University	26	70	1	
Occupation				
Employed	17	63	1	1
Merchant	11	20	2.0 (0.8-5.1)	2.1 (0.7-6.3)
Farmer	14	63	0.8 (0.37-1.8)	0.9 (0.3-2.7)
House wife	27	59	1.7 (0.84-3.4)	0.88 (0.3-2.1)
Retired	35	15	8.6 (3.8-19.4)	2.7 (0.9-7.5)
Not employed	10	54	0.69 (0.3-1.6)	0.5 (0.2-1.6)
Residence				
Urban	86	167	1.97 (1.2-3.21)	0.91 (0.34-2.33)
Rural	28	107	1	
Monthly income				
<400	16	50	1.05 (0.5-2.2)	2.18 (0.58-8.26)
400-699	34	70	1.6 (0.86-2.9)	3.85(1.36-10.87)
700-1999	40	75	1.8 (0.96-3.2)	2.18 (0.83-5.70)
>/=2000	24	79	1	
Alcohol				
Yes	14	10	3.7 (1.6- 8.6)	3.7 (0.85-7.85)
No	100	264	1	

Physical activity				
Yes	49	176	1	
No	65	98	2.4 (1.5-3.7)	2.1(1.2-3.7)**
History of Eye exam				
Yes	84	116	3.8 (2.4-6.2)	1.9 (1.05-3.4)*
No	30	158	1	1
BMI				
Normal weight	63	197	1	1
Underweight	10	15	2.1 (0.9-4.8)	6.2 (2.1-18.9)**
Overweight & Obsess	41	62	2.1 (1.3-3.4)	0.9 (0.5-1.9)
Type of DM				
Type 1	22	138	1	
Type 2	92	136	4.2 (2.5-7.15)	1.95 (0.65-5.83)
Duration of DM since diagnosis				
[0-5)	55	177	1	
[5-10)	29	70	1.3 (0.78-2.3)	0.76 (0.38-1.55)
[10-15)	14	19	2.4 (1.1-5.0)	0.44 (0.15-1.27)
15+	16	8	6.4 (2.6-15.8)	1.45 (0.42-4.92)
Mode of treatment				
Tablets	67	107	2.2 (1.4-3.5)	0.5 (0.2-1.04)
Injections	47	167	1	1
Recent FBS				
Normal	42	97	1	
Hyperglycemia	72	177	0.94 (0.6-1.5)	
Visual Symptom				
Symptomatic	91	113	5.6 (3.36-9.4)	4.1 (2.2-7.6)***
Asymptomatic	23	161	1	1
Hypertension				
Yes	51	44	4.2 (2.6-6.9)	1.27 (0.61-2.66)
No	63	230	1	
HIV				
Negative	93	235	1	
Positive	11	10	2.7 (1.14-6.8)	2.21 (0.63-7.80)
Don't know	10	29	0.87 (0.4-1.86)	0.93 (0.34-2.50)

(n = sample size) (* *p value <0.05)* *(** p value <0.01)* *(*** p value <0.001)*

5 Discussion

The prevalence of visual impairment among diabetic patients attending Debre Berhan referral hospital, North Shoa Ethiopia, was found to be 29.38% (95% CI: 24.83%-33.93 %).

This proportion of visual impairment was higher than those studies done in China (12.2%) (8), Tunisia (22.2%) (7), Nigeria (16.7%) (17) and Cameroon (22.6%) (9). The possible difference between this study from the Chinese and Tunisian studies may be due to differences in the definition of visual impairment. The Chinese study used the best corrected visual acuity to define visual impairment, unlike this study which used presenting visual acuity. Best corrected visual acuity underestimates the real burden of visual impairment. The Tunisian study used the better eye vision to say visual impairment. If a person's one eye is normal and the other is impaired, this person will not be considered as visually impaired when the better eye definition is used. But in this study monocular visual impairment was incorporated according to the ICD update and revision platform (1). The Nigerian and the Cameroonian study used a very small sample size, 84 and 96 respectively, which may be the reason for their small prevalence of visual impairment as compared to this study.

However, the prevalence of visual impairment in this study was lower than studies done in South Africa (44.9%) (16) and Yemen (55%) (12). The study participants were diabetic patients aged 40 years and older in the South African study and aged 18 years and above in this study. The relatively older study participants may be the reason for higher prevalence of visual impairment in the South African study. It may also be due to differences in visual impairment definition. Visual acuity of <6/9.5 was grouped to visual impairment in the South African study as compared to this study which was VA of <6/18.

Socio-cultural variations may be responsible for the wide difference between the Yemeni and this study. Because of familial clustering and the high rate of consanguinity in the Yemeni population, which are genetic risk factors for early onset type 2 DM, higher diabetes mellitus complications are expected that may result in visual impairment (12, 24, 25). The Yemenis diabetic patients had longer duration of

diabetes than this study subjects. In the Yemeni study, 52% of study population had DM for more than 10 years whereas only less than 15% of study population had DM for more than 10 year in this study.

The prevalence of visual impairment in this study was in line with a study done in Uganda (28.6%) (18). This may be due to similarities in ages of study participants (≥18years), use of presenting visual acuity and the cut off point for visual impairment (VA <6/18).

In this study, older age was positively associated with visual impairment which was consistent with other studies done in China(8), Singapore (15), South Africa(16), Tunisia (7), Yemen (12) and Uganda(18). The possible reason for increased visual impairment in old age may be due to, increased age related eye diseases with old age and because of long duration of DM with older age, that may result in diabetic complications in the eyes.

Physical inactivity was positively associated with visual impairment which was in line with the South African study. The reason for this may be due to the poor control of diabetes in people who were not engaged in physical activities.

History of eye examination was positively associated with visual impairment in diabetic patients in this study. The reason for this may be because of the fact that people with visual impairment are more likely to be examined their eyes than those without visual impairment. Even if they were examined, visual impairing conditions may have not be treated for different reasons like waiting the cataract till it matures or due to financial problems. Ocular conditions like DR, Glaucoma and AMD can cause visual impairment that cannot be avoided.

Presence of visual symptoms were also positively associated with visual impairment in this study which was in line with the Ugandan study. Visual impairment is most likely to have symptoms like blurring of vision. So the positive association of visual impairment and visual symptoms is likely.

Patients with lower BMI in this study were positively associated with visual impairment which was in agreement with a multi-ethnic Asian study. But in the Tunisians study, it was BMI >25 (overweight) that had statistically significant association. This may be because the majority (89%) of Tunisian study subjects were type 2 diabetics as compared to our study participants which were only 58.8%. Overweight individuals are more likely to be Type 2 diabetics (13).

However, factors like sex, monthly income , duration of DM, hypertension were not associated with visual impairment in our study which were previously reported to have association with visual impairment in other studies (6-9, 12, 15, 18). In this study, the duration of diabetes mellitus is shorter than those of the Yemeni study participants. In the Yemenis study, 52% of their study participants had DM for more than 10 years whereas less than 15% had More than 10 year in this study. Moreover, the duration was as high as 49 years in Yemenis diabetic patients which is much higher than our diabetic patients which was 28 years. This may be the reason that duration is associated in their study but not in this study.

5.1 **Limitations of the study**

Visual impairment was not was defined in terms of visual field because of feasibility issues. Since the study was cross sectional no follow ups were done and fluctuations of vision with fluctuations blood sugar level was not considered. The study was conducted at a single center.

6 Conclusion

About one third of diabetic patients had visual impairment. Older age, physical inactivity, history of eye examination, presence of visual symptoms and lower BMI were significantly associated with visual impairment in diabetic patients.

7 Recommendations

It is recommended for DBRH (Ophthalmology department) to:

Provide affordable eye care services for diabetic patients with visual impairment to avoid visual impairment.

It is recommended for DBRH chronic disease department to:

Advice diabetic patients to normalize their BMI and have regular physical activities.

It is recommended for researchers to:

Conduct further studies on visual impairment among diabetic patients by involving larger study population and multi centers.

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Annexes

Annex 1 Information Sheet

Title of the research project – Prevalence and associated factors of visual impairment among diabetic patients attending Debre Berhan referral hospital, 2017.

Name of principal investigator – Ketemaw Zewdu

Name of organization- University of Gondar, Gondar College of Medicine and Health Sciences, School of medicine, Department of Optometry

Name of sponsor - Amhara National Regional State health bureau

Introduction

This information sheet and consent form was prepared with the aim of studying the prevalence and associated factors of visual impairment among diabetic patients at Debre Berhan Referral Hospital, 2017. The research group included the principal investigator, six trained data collectors and two advisors from University of Gondar.

Purpose of the research project

The main purpose of this study was to assess the prevalence and associated factors of visual impairment among diabetic patients at Debre Berhan referral hospital.

Procedures

The study involved diabetic patients who were 18 years old and above from April 27 to may 19, 2017. All diabetic patients at Debre Berhan referral hospital and who consented to participate were included to the study. Questions regarding socio-demography, knowledge about the effect of DM on the eye, behavioral factors and clinical conditions were asked or taken from the patients' folder. The vision of the patients was checked and anterior and posterior segment examinations were done.

Benefits, Risks and/of Discomfort

By participating in this research project, it may waste some of your time (a maximum of 25 minutes). However your participation is definitely important to

assess prevalence of visual impairment and associated factors among diabetic patients in Debre Berhan referral hospital. It is also important to design appropriate strategy for the avoidance of these vision impairing conditions. There is no risk in participating in this research project. Your benefit is free and full ocular examination.

Incentives/Payments for Participating

You will not be provided any incentives or payments to take part in this project.

Confidentiality

Your name will not be written and the information collected from you will be kept confidential and stored in a file, by giving a code. Hence, no report of the study will ever identify you.

Right to Refusal or Withdraw

You have full right to refuse from participating in this research and to withdraw at any time you wish.

Person to contact

This research project was reviewed and approved by the ethical committee of the University of Gondar. If you have any question you can contact any of the following individuals and you may ask at any time you want.

Name: Ketemaw Zewdu	Name: Nebiyat Fleke	Name: Destaye Shiferaw
Tele: 0918150629	Tele: 0918035619	Tele: 0918032216

Annex 2 Informed Consent Form (English Version)

Name of the participant ---------- ID----------

Consent form for interview and eye examination to asses visual impairment and associated factors in DM patients.

Dear sir/madam

You are selected to participate in a study on the prevalence and associated factors of visual impairment among diabetic patients at DBRH. It will take a maximum of 25 minutes. The data obtained from you will be collected for research purpose. It will indirectly contribute in bringing solutions to avoid visual impairment in diabetic patients.

With your permission, we would like to conduct some interviews and examine your eyes. Your participation is voluntary and you have the right to refuse the participation or withdraw your consent at any time. All the information we collect will be confidential and no identifiable information will be released. Your response will never be exposed to anyone.

Would you like to participate in the study?

Yes..... No.....

I understand this consent and the purpose of the study have been explained to me by a language I can understand. I am voluntary to participate in the study.

Participant----------sign---------date----------

Researcher/witness ---------- sign--------- date ----------

Annex 3 Informed Consent (Amharic Version)

የተከበሩ አቶ/ወይዘሮ/ወይዘሪት _____

በደብረ ብርሃን ሪፈራል ሆስፒታል የስኳር ሕመም ታካሚዎች የእይታ ችግር/እክል ላይ በሚደረገው ጥናት ይሳተፉ ዘንድ ተመርጠዋል፡፡ ከእርስዎ የምናገኘው መረጃ ለጥናትና ምርምር ጥቅም የሚውል ሲሆን ይህም ለወደፊት በስኳር ሕመምተኞች ላይ ያለውን የእይታ ችግር ለማስወገድ ለሚደረገው ዕቅድ እንደ ግብዐት ያገለግላል፡፡ ፈቃደኛ ከሆኑ አንዳንድ ጥያቄዎችን ጠይቀን ዓይንዎትን እንመረምርዎታለን፡፡ በዚህ ጥናት ላይ የሚያደርጉት ተሳተፎ በእርስዎ ፈቃድ የተመሰረተ ሲሆን ተሳተፎውን መቀጠል ካልፈለጉ በማንኛውም ሠዓት ማቋረጥ ይችላሉ፡፡ ከእርስዎ የሚወሰድ ማንኛውም መረጃ በሚስጥር የተጠበቀ ሲሆን በጥናቱ ላይም የእርስዎን ማንነት የሚገልጽ ነገር አይገለጽም፡፡

ጥናቱን መሳተፍ ይፈልጋሉ? 1) አዎ 2) አልፈልግም

የጥናቱ ዓላማና ጥቅም በሚገባኝ ቋንቋ ተገልጾልኝና ተረድቼ በጥናቱ ለመሳተፍ ፈቃደኛ ነኝ፡፡

የተሳታፊው ስም _____ፊርማ _____ቀን _____

Annex 4 English version of questionnaire

Pre tested and semi structured questioners with data extraction form for prevalence and associated factors of visual impairment among diabetic patients in DBRH, North Shoa, Ethiopia.

Introduction

Good morning/afternoon, my name is ----------. I am a member of a research group which studies the prevalence and associated factors of visual impairment among diabetic patients in Debre Berhan referral hospital. You are kindly invited be one of the study participants in our project. Your truth full answers for all of our questions and good cooperation during the examination are very important to determine the prevalence and associated factors of visual impairment among diabetic patients. Your answers will be confidential and secret. It is your right not to participate in the study, stop at any time or skip any question you do not want to answer. But we appreciate that if you participate.

Thank you.

Next, I will read a consent, which assures your interest to participate.

Do I have your permission to continue?
If yes thank you and continue ----------
If no, thank you and go to next study subject ----------

Data collector

Name ---------- signature ---------- date ----------

Checked by supervisor

Name ---------- signature---------- date----------

Part 1. Socio-demographic data

1. ID _____
2. Age (year) _____
3. Sex 1) Male 2) Female
4. Religion 1) Orthodox 2)Muslim 3)Protestant
   4) Catholic 5) Other Specify_____
5. Ethnicity 1) Amhara 2) Oromo 3)Afar 4)Tigrie
   5) Other specify_____
6. Marital status 1) Single 2) Married 3) Widowed 4) Divorced
7. Educational status 1) cannot read and write 2) Can read and write only 3) primary school 4) Secondary school 5) College/University
8. Occupation 1) daily laborer 2) merchant 3) employed 4) farmer
   5) house wife 6) retired 7) not employed 8) Other specify
9. Residence 1) Urban 2) Rural
10. Monthly income _____ETB

Part 2. Data on behavioral factors

11. Do you drink alcohol? if no go to question 21. 1) Yes 2) No
12. How frequent?_____ How many units?_____
13. Do you do physical exercises ? if no go to question 25. 1) Yes 2) No
14. How frequent?_____ How long?_____
15. Have you been examined your eye before? if no go to question 27.
    1)Yes 2)No
16. When? 1) within 1 week 2) 1week -1 month 3) 1 month - 6 months
    4) 6 months- one year 5) before one year 6) I don't remember

Part 3. Clinical data

17. BMI _____height(m) _____weight(kg)_____
18. Type of DM 1) Type 1 2) Type 2
19. Duration of DM since diagnosis? _____Years
20. Level of recent fasting blood sugar? _____mg/dl
21. Mode of treatment? 1) tablets 2) injections 3) diet

22. Are there any visual symptoms you know? 1) Yes 2) No

Part 4. Data on systemic co-morbidities

23. HPN? 1) Yes 2) No

24. HIV? 1) Positive 2) Negative 3) I don't know

Part 5. Data on ocular examination

		Right eye	Left eye
25.	Distance PVA		
26.	PH		
27.	Ocular abnormalities	1. Normal ☐ 2. Cataract ☐ 3. RE ☐ 4. DR ☐ 5. Glaucoma ☐ 6. Others specify----------	1. Normal ☐ 2. Cataract ☐ 3. RE ☐ 4. DR ☐ 5. Glaucoma ☐ 6. Others specify------

Thank you!

Annex 5 Amharic version of questionnaire

<u>የአማርኛ መጠይቅ ቅጽ</u>

ጤና ይስጥልኝ እኔ .....እባላለሁ፡፡ የመጣሁት ከጎንደር ዩኒቨርስቲ ነዉ፡፡ በደብረ ብርሃን ሪፈራል ሆስፒታል የስኳር ሕመም ታካሚዎች የእይታ ችግር/እክል እና ተዛማጅ ምክንያቶች ዙሪያ የዳሰሳ ጥናት አባል ነኝ፡፡ እርስዎ ጥናቱን ይሳተፉ ዘንድ በአክብሮት እንጠይቃለን፡፡ በእይታ እክል/ችግር እና ተዛማጅ ምክንያቶች በተመለከተ ለምንጠይቅዎት ጥያቄወች የሚሰጡን ትክክለኛ መልስ እና ዓይንዎትን በምንመረምርበት ወቅት የሚያደርጉልን ትብብር ለጥናቱ በጣም ጠቃሚ ድርሻ አለው፡፡ ከእርስዎ የሚወሰድ ማንኛውም መረጃ በሚስጥር የተጠበቀ ነው፡፡ በጥናቱ ላይ አሁንም ሆነ መሀል ላይ መሳተፍ ባይፈልጉ ተሳትፎውን ማቋረጥ መብትዎ ነዉ፡፡ ነገር ግን ጥናቱ ከሚሰጠዉ ጥቅም አንጻር ቢሳተፉ ደስ ይለናል፡፡ መጠይቁን ለማጠናቀቅ ቢበዛ 25 ደቂቃ ይወስዳል፡፡

ጥናቱን መሳተፍ ይፈልጋሉ?

አመሰግናለሁ፤ከዚህ በመቀጠል ለመሳተፍ ፈቃደኝነትዎን የማረጋገጫ ጽሑፍ አነብለዎታለሁ፡፡

ለመቀጠል ይስማማሉ?

ከተስማሙ አመሰግናለሁ፡፡ መጠይቁ ይቀጥላል፡፡

ካልተስማሙም አመስግነህ ቀጣዩን ተሳታፊ ጠይቅ፡፡

<u>መረጃ ሰብሳቢ</u>

ስም……..

ፊርማ…… ቀን……..

<u>ያረጋገጠዉ ተቆጣጣሪ</u>

ስም……

ፊርማ…….. ቀን……

ክፍል 1. ማህበራዊ እና ስነ ህዝባዊ መረጃ

1. መለያ ቁጥር _____
2. እድሜ በዓመት _____
3. ጾታ 1) ወንድ 2) ሴት
4. ሃይማኖት 1) ኦርቶዶክስ 2) ሙስሊም 3) ፕሮቲስታነት 4) ካቶሊክ 5) ሌላ ይጥቀሱ
5. ብሔር 1) አማራ 2) ኦሮሞ 3)አፋር 4)ትግሬ 5) ሌላ ይጥቀሱ
6. የጋበቻ ሁኔታ 1) ያላገባ/ች 2) ያገባ/ች 3) የሞተበት/ባት 4) የፈታ/ች
7. የትምህርት ደረጃ 1) ማንበብና መጻፍ የማይችል 2) ማንበብና መጻፍ ብቻ የሚችል 3) አንደኛ ደረጃ 4) ሁለተኛ ደረጃ 5) ኮሌጅ/ዩኒቨርስቲ
8. ሥራ 1) የቀን ሠራተኛ 2) ነጋዴ 3) ተቀጠሮ የሚሰራ/የምትሰራ 4) አርሶ አደር 5) የቤት እመቤት 6) ጡረታ 7) ሥራ የሌለው/ላት 8) ሌላ ይጥቀሱ
9. መኖሪያ ቦታ 1) ከተማ 2) ገጠር
10. ወርሃዊ ገቢ ብር _____

ክፍል 2.

11. አልኮል ይጠጣሉ ? *(መልሱ የለም ከሆነ ወደ ጥያቄ 21 ይለፉ)* 1)አዎ 2)የለም
12. በየ ሥንት ጊዜው ይጠጣሉ_____ ምን ያክል ይጠጣሉ? _____
13. የአካል ብቃት እንቅስቃሴ ያደርጋሉ? *(መልሱ የለም ከሆነ ወደ ጥያቄ 25 ይለፉ)* 1)አዎ 2)የለም
14. በየ ሥንት ጊዜውይሰራሉ_____ ምን ያክል ደቂቃ ይሰራሉ? _____
15. ከዚህ በፊት ዓይንዎትን ተመርምረው ያውቃሉ? *(መልሱ የለም ከሆነ ወደ ጥያቄ 27 ይለፉ)*

    1) አዎ 2) የለም
16. ዓይንዎትን መቼ ነበር የተመረመሩት? 1) ከ1 ሳምንት ወዲህ 2) ከ1 ሳምንት -1 ወር ወዲህ 3) ከ1 ወር -6 ወር 4) ከ6 ወር -1 ዓመት ወዲህ 5) ከ 1 ዓመት በፊት 6) አላሰታውስም
17. ክፍል 3. የሕክምና ምርመራን የተመለከተ መረጃ
18. BMI _____ ቁመት በሜ. _____ ክብደት በኪ.ግ. _____
19. የስኳር ሕመም ዓይነት ዓይነት 1) ዓይነት 1 2) ዓይነት 2
20. ስኳሩ ካወቁ ምን ያክል ጊዜ ሆነው? _____ዓመት

21. የስኳሩ መጠን ስንት ነው?(FBS) _____ Mg/dl

22. የሚወስዱት የመድኃኒት ዓይነት? 1. የሚዋጥ 2. በመረፌ የሚወጋ 3. አመጋገብ

23. እርስዎ የሚያውቁት የእይታ ችግር አለ? 1)አለ 2)የለም

ክፍል 5. አጠቃላይ ጤንነትን የተመለከተ መረጃ

24. የደም ግፊት አለበዎት ? 1) አለ 2)የለም

25. ኤቸ አይ ቪ ? 1) አለ 2)የለም 3) አላውቅም

ክፍል 5. የዓይን ምርመራን የተመለከተ መረጃ

		Right eye	Left eye
26.	Distance PVA		
27.	PH		
28.	Ocular abnormalities	1) Normal ☐ 2) Cataract ☐ 3) RE ☐ 4) DR ☐ 5) Glaucoma ☐ 6) others specify------	1) Normal ☐ 2) Cataract ☐ 3) RE ☐ 4) DR ☐ 5) Glaucoma ☐ 6) others specify------

እናመሰግናለን!

Annex 6 Declaration

I, the undersigned, senior clinical optometry student declare that this thesis result is my original work in partial fulfillment of the requirements for the Masters degree in Clinical Optometry.

Name: **Ketemaw Zewdu**

Signature: ----------

Place of submission: University of Gondar, College of Medicine and Health Sciences, Department of Optometry

Date of Submission: ----------

This thesis report work has been submitted for ethical review with my/our approval as university advisor(s).

Advisors

Name	Signature	Date
1. Mr. Nebiyat Feleke	----------	----------
2. Mr. Destaye Shiferaw	----------	----------

Annex 7 Assurance Of Investigator

I, the undersigned agrees to accept responsibility for the scientific, ethical and technical conduct of the research project and for provision of required progress reports as pre terms and conditions of the research and publications office of the University of Gondar.

Name of the student: Ketemaw Zewdu

Date: ---------- Signature: ----------

Approval of the advisor (s)

Advisors

Name	Signature	Date
1. Mr. Nebiyat Feleke	----------	----------
2. Mr. Destaye Shiferaw	----------	----------